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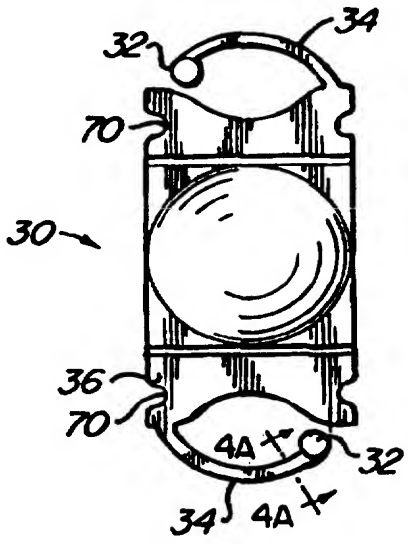
(54) Title: INTRAOCULAR LENSES WITH FIXATED HAPTICS

(57) Abstract

An intraocular lens (30) for implanting within a natural capsular bag of a human eye has structural means or features (32) on its distal portions enlarged and sized to prevent movement or sliding thereof relative to fibrosis pockets defined about proximally adjacent haptic portions (34) to retain the haptic against movement and dislocation.



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Description

INTRAOCULAR LENSES WITH FIXATED HAPTICS

Technical Field

In the replacement of an intraocular lens, as in cataract surgery, the practice is to remove the cataractous natural lens and replace it with a man-made lens. The replacement lens is placed inside the natural capsular bag of the natural human lens.

Background Art

Replacement of the natural lens by artificial intraocular lens is discussed in my U.S. Patent No. 5,476,514 and in my U.S. Patent No. 5,047,051.

The present invention represents improvements over my above-mentioned patents relative to the fixation or anchoring of the lens haptics in the bag, thereby overcoming certain potential disadvantages of plate haptic lenses. My patents disclose methods of fixing a haptic plate in the capsular bag by means of mini-loops at the ends of haptic anchor plates. This enables the bag to fibrose about the loops to fix the lens in the bag.

In such procedures, plate haptic lenses can only be implanted with a continuous circular capsulotomy

which is defined by the surgeon in the anterior capsule, requiring a high degree of skill. Such capsulotomy leaves the posterior bag and an anterior circular capsular rim reduced by the circular capsulotomy. The remnant of the anterior capsule focuses fibrosis over portions of the artificial lens and fuses with the posterior capsule, thus to fix the intraocular lens in the bag. After fibrosis is complete, brain-initiated relaxation and constriction of the ciliary muscle of the eye cause accommodation of the lens in the manner described in my U.S. Patent No. 5,476,514.

During the healing and fibrosis process, the anterior capsule rim becomes fused to the posterior capsule by fibrosis, and a plate haptic or appendage thereof is retained in position by a pocket or tunnel defined by the fibrosis about the haptic portions between the anterior capsular rim and the posterior capsule.

Disclosure of Invention

As discussed in the foregoing background, a plate haptic is retained in place by a pocket or tunnel defined in fibrosis about a haptic portion between the anterior capsular rim and the posterior capsule.

The fibrosis fuses together the anterior and

posterior capsules, and surrounds portions of a plate haptic.

Plate haptic lenses are desirable because they provide substantial advantages over loop lenses, these advantages including stabilization of the vitreous with substantially less probability of the most serious complications of cataract surgery, these being cystoid macular edema and retinal detachment. Another advantage is the consistent posterior location of the optic, which not only stabilizes the vitreous, but provides more predictable post-operative, uncorrected visual acuity. A further advantage is that the posterior location of the lens results in tight contact of the lens with the posterior capsule, thereby resulting in reduced rate of opacification of the posterior capsule with resultant reduced posterior capsulotomy rate.

The present invention provides haptic lens features which greatly assist in the prevention of plate lens dislocation and slipping from proper positions in the pocket formed thereabout by fibrosis. Enlarged and/or distal haptic portions are provided which are prevented by their larger dimension from moving or sliding along pockets formed by fibrosis about proximally inward haptic portions. The enlarged distal structural features prevent the haptic from

sliding inwardly relative to such fibrosis pockets and prevent dislocation of the intraocular lens. The enlarged distal structural features may take such forms as: protuberances extending from one or both sides of distal portions of plate haptics; flexible extensions extending, typically diagonally, from distal corners of lens plate haptics which extensions may have protuberances; protuberances extending outwardly from spring loops extending from distal portions of haptics; enlarged end portions or protuberances on distal portions of a plurality of haptics extending from their wide proximal ends at an optic; enlarged wide distal portions of haptics tapered to widen in the distal direction; prong protuberances extending laterally outwardly from distal portions of plate haptics; and notches in side edges of distal portions of haptics.

Brief Description of Drawings

Figure 1 is an elevational view of a preferred embodiment of the invention, showing a plate haptic lens with enlarged protuberances at its distal corners;

Figure 2 is a sectional view taken at 2-2 in Figure 1;

Figure 3 is an elevational view of an embodiment of the invention wherein flexible extensions with protuberances extend diagonally outwardly from distal

corners of haptic plates;

Figure 3A is a sectional view taken at 3A-3A in Figure 3;

Figure 4 is an elevational view of a haptic plate lens with spring loops extending outwardly with enlarged portions or protuberances on the loops;

Figure 4A is a sectional view taken at 4A-4A in Figure 4;

Figure 5 illustrates an embodiment of the invention wherein a plurality of symmetrically tapered haptics extend from wide proximal ends joined to an optic to relatively narrow distal ends whereon protuberances are disposed;

Figure 5A is a sectional view taken at 5A-5A in Figure 5;

Figure 6 is a perspective view of an embodiment wherein each of oppositely-extending haptics has a distal portion wider than inward or proximal haptic portions; and

Figure 7 is an elevational view of an embodiment of the invention wherein are shown in partial views two forms of prong protuberances extending laterally outwardly from distal portions of oppositely extending haptics.

Best Mode for Carrying Out the Invention

As hereinbefore mentioned, the invention provides lens features which greatly reduce the probability of plate lens dislocation and slippage from their proper positions in fibrosis pockets.

Fibrosis of the capsular rim occurs about the enlarged structural and the distal portion or portions to fixate the lens within the capsular bag, the fibrosis forming about the lens haptics to form pockets in which the haptics slide when they flex during accommodation of the lens - i.e., during anterior-posterior optic movement.

Under certain circumstances, as when a tear occurs in the capsular bag during fibrosis, shrinkage of the capsular bag during fibrosis may cause enlargement of such tear. Such tear enlargement, or other loosening, may cause a haptic to slip or slide relative to the pocket, thus causing dislocation of the lens. Such dislocation can possibly result in the plate haptic falling into or becoming positioned in the vitreous and being positioned in the posterior portion of the eye. This is a relatively serious medical complication.

The invention provides enlarged and/or extending distal haptic portions which will not move or slide along the pocket formed by fibrosis about proximally inward haptic portions of smaller size. That is, an

enlarged distal structural feature will prevent the haptic from sliding along such pocket.

In the embodiments of the invention herein described, distal structural features have larger dimensions than proximally inward haptic portions disposed in fibrosed pockets, to prevent the haptic from becoming dislocated by slipping or shifting relative to the fibrosis pockets in which inward portions of the haptics are disposed.

Referring to the drawings, and particularly to Figure 1, a preferred embodiment 10 has an outer or distal portion of a plate haptic 12 with protuberances 14 thereon. The sectional view of Figure 2 shows the configuration of the protuberances 14 which extend from both sides or surfaces of haptic 12. A protuberance (not shown) may extend from only one side or surface of the haptic. The protuberances will not pass or slide through a fibrosis pocket disposed about proximally adjacent smaller dimensional portions of the haptic 12.

Figures 3 and 3A illustrate another embodiment wherein flexible extensions 20 extend diagonally from outer distal corners of lens plate haptics 22, and have protuberances 24 at their ends. The diagonal extensions 20 position the protuberances laterally and distally outwardly of the edges of the haptic. The protuberances are thus prevented from moving or sliding

through a pocket defined by fibrosis about the proximal or inward portions of the haptics. Figure 3A shows the cross-sectional configuration of the protuberances.

Figures 4 and 4A illustrate an embodiment 30 of the invention wherein protuberances 32 extend outwardly from spring loops 34 which extend from and comprise parts of the distal portions of haptics 36. The protuberances 32 prevent the loop and the distal portions of the haptic plates from moving or sliding relative to fibrosis pockets formed about the loop and distal portions of the haptics. Figure 4A shows in cross-section the configuration of the protuberances at the ends of the loops. A lens (not shown) generally similar to that of Figure 4, may have a loop element attached to a haptic plate, as by fusion or adhesure, rather than the loop being integrally formed with the plate.

Figure 5 illustrates an embodiment 40 of the invention, wherein a plurality of haptics 42 are each symmetrically tapered outwardly from relatively wide proximal ends, which are joined to the optic 44, to relatively narrow distal ends whereon protuberances 46 are disposed. Figure 5A shows details of a protuberance.

Figure 6 illustrates an embodiment 50, which is not an accommodation lens, wherein each of plate

haptics 52 has a wider distal protuberance portion 54 than proximally adjacent haptic portions. Wider distal protuberance portions of the haptics are defined by tapered configurations of the haptics which widen in the distal direction. The wider distal haptic portion prevents movement of the haptic in the distal direction, toward the optic, and is retained against movement relative to the pocket defined by fibrosis about the plate haptic inwardly of the distal portion.

Figure 7 illustrates another embodiment 60 of the invention wherein prong protuberances 62 with pointed ends or prongs 64 with rounded ends, extend laterally outwardly from distal portions of plate haptics extending from an optic 66. It will be understood that the prong protuberances 62 effectively prevent proximal movement toward the optic 64 of the inward portions of the haptics relative to the fibrosis pocket formed about proximally inward portions of the haptics.

Figures 1, 3 and 4 to 7 illustrate embodiments of the invention wherein notches 70 are defined in distal edge portions of plate haptics. Preferably, a notch 70 is defined in both lateral edges of the distal portion of a haptic, and notches are preferably defined in the lateral edges of the distal portions of at least two haptics extending in different directions from an optic. As shown, the notch 70 typically has an edge

portion which is disposed at a substantial angle to or substantially transversely of the side edge or longitudinal axis of the haptic. Such notches and edge portions are thus disposed to prevent the haptics from becoming dislocated by preventing shifting or sliding thereof relative to fibrosis pockets in which proximally inward portions of the haptics are disposed.

Claims

1. An intraocular lens implant within a human eye having a natural capsular bag attached about its perimeter to the ciliary muscle of the eye and from which the natural lens matrix has been removed, the bag including an elastic posterior capsule urged anteriorly by vitreous pressure and an anterior capsule opening circumferentially surrounded by a capsular remnant fused by fibrose tissue to the posterior capsule, said lens implant comprising:

an intraocular lens having normally anterior and posterior sides and including a central optic, and haptics extending outwardly from the optic and having inner proximal ends joined to the optic and opposite outer distal end portions, and wherein

said intraocular lens is situated within said capsular bag with the outer end portions of said haptics disposed between said remnant and said posterior capsule and disposed in pockets defined in and by the fibrose tissue, and

at least one structural feature on the distal portion of at least one of two haptics extending in different directions from the optic, said structural feature having a dimension greater than

a corresponding dimension of a proximally adjacent haptic portion disposed in a fibrosis pocket to retain the haptic against movement in the proximal direction relative to said pocket.

2. An intraocular lens according to Claim 1, wherein: said at least one structural feature is provided on the distal ends of each of said two plate haptics extending in different directions from the optic, and are sized and configurated to substantially prevent entry thereof into said pockets defined by fibrosis about adjacent proximally adjacent haptics portions, whereby the respective haptics are fixated and retained against movement in the proximal direction toward the optic.

3. An intraocular lens according to Claim 1, wherein said at least one structural feature on said at least one plate haptic distal portion comprises at least one protuberance extending from at least one side of the haptic.

4. An intraocular lens according to Claim 1, wherein: said at least one structural feature comprises protuberances extending outwardly from

anterior and posterior sides of at least two haptics extending in different directions from the optic.

5. An intraocular lens according to Claim 1, wherein:

said haptic distal portion comprises a loop, and

said at least one structural feature on said distal portion comprises a protuberance extending outwardly from at least one side of the loop.

6. An intraocular lens according to Claim 5, wherein said protuberance extends from both the anterior and posterior sides of said loop.

7. An intraocular lens according to Claim 1, wherein said at least one structural feature on the distal portion of at least one haptic comprises enlarged end portions of flexible fingers extending diagonally outwardly from distal corners of the at least one said haptic.

8. An intraocular lens according to Claim 7, wherein at least two flexible fingers extend diagonally from opposite distal corners of each of two haptics.

9. An intraocular lens according to Claim 8, wherein protuberances extend outwardly from at least one side of said fingers.

10. An intraocular lens according to Claim 9, wherein: said at least one structural feature on the distal portion of at least one haptic comprises at least one prong protuberance extending laterally outwardly from the distal portion of the haptic.

11. An intraocular lens according to Claim 10, wherein prong protuberances extend outwardly from each side of the distal portion of the at least one haptic.

12. An intraocular lens according to Claim 11, wherein prong protuberances extend outwardly from each side of the distal end portions of each of the two haptics.

13. An intraocular lens according to Claim 1, wherein: said at least one structural feature on the distal portion of at least one haptic comprises a wide distal end portion of the haptic defined by the haptic being longitudinally tapered to widen toward its distal end.

14. An intraocular lens according to Claim 13, wherein said at least one structural feature comprises wide distal end portions on two haptics extending oppositely from the optic.

15. An intraocular lens according to Claim 1, wherein:

said at least one structural feature of at least one plate haptic distal portion comprises a notch defined in at least one edge portion of the plate haptic distal portion to substantially prevent entry of the notch edge into said fibrosis pocket defined by fibrosis about said proximally adjacent haptics portion to retain the haptic against movement in the proximal direction.

16. An intraocular lens according to Claim 15, wherein:

said at least one structural feature of at least one plate haptic distal portion comprises a notch defined in each of the side edge portions of the plate haptic distal portions.

17. An intraocular lens according to Claim 15, wherein:

said at least one structural feature comprises a notch defined in at least one edge

portion of the distal portions of at least two haptics extending at different angles from the optic.

18. An intraocular lens according to Claim 15, wherein:

said at least one structural feature comprises a notch defined in each edge portion of the distal portions of at least two haptics extending at different angles from the optic.

19. An accommodating intraocular lens comprising:

a lens body having normally anterior and posterior sides and including an optic and plate haptics extending from their proximal ends at the optic to their distal ends, and wherein

said lens is adapted to be implanted in a human eye within a natural capsular bag in the eye attached about its perimeter to the ciliary muscle of the eye and including an elastic posterior capsule which is urged anteriorly by vitreous pressure in the eye and an anterior capsule opening bounded circumferentially by an anterior capsule remnant that fuses to the posterior capsule by fibrosis during a postoperative fibrosis period in which said bag and remnant

shrink, said remnant being tautly stretched by relaxation of the ciliary muscle and relaxed by contraction of the ciliary muscle after fibrosis is complete,

said lens is adapted to be implanted in said bag while said ciliary muscle is in its relaxed state and in an implanted position wherein said optic is aligned with said anterior capsule opening and said plate haptics are disposed between said posterior capsule and said anterior capsule remnant, whereby said fibrosis occurs and defines respective pockets about portions of said respective plate haptics and said optic is urged posteriorly against said posterior capsule during fibrosis, and after fibrosis is complete, relaxation of the ciliary muscle effects posterior movement of said optic to a distant vision position and contraction of the ciliary muscle effects anterior accommodation movement of the optic, and

structural means on said distal end of at least one of two plate haptics and being sized and configurated to substantially prevent entry thereof into said fibrosis pockets defined by fibrosis about proximally adjacent plate haptic portions, whereby the distal ends of said haptics

are fixated and retained against movement in the proximal direction toward the optic.

20. An accommodating intraocular lens according to Claim 19, wherein:

said structural means are provided on the distal ends of each of said two plate haptics extending in different directions from the optic, and are sized and configurated to substantially prevent entry thereof into said pockets defined by fibrosis about proximally adjacent haptics portions, whereby the respective haptics are fixated and retained against movement in the proximal direction toward the optic.

21. An accommodating intraocular lens according to Claim 19, wherein:

said at least one structural means on said at least one plate haptic distal portion comprises at least one protuberance extending from at least one side of the haptic.

22. An accommodating intraocular lens according to Claim 20, wherein:

said structural means on said distal ends of each of said two plate haptics extending in

different directions comprise protuberances extending outwardly from anterior and posterior sides of the haptic of at least two haptics extending in different directions from the optic.

23. An accommodating intraocular lens according to Claim 19, wherein:

said distal end of said at least one plate haptic comprises a loop, and

said at least one structural means on said distal end of said at least one haptic comprises a protuberance extending outwardly from at least one side of the loop.

24. An accommodating intraocular lens according to Claim 23 wherein said structural means comprises a protuberance extending from both the anterior and posterior sides of said loop.

25. An accommodating intraocular lens according to Claim 19 wherein said structural means on the distal end of at least one plate haptic comprises enlarged end portions of flexible fingers extending diagonally outwardly from distal corners of the at least one haptic.

26. An accommodating intraocular lens according to Claim 25 wherein at least two flexible fingers extend diagonally from opposite distal corners of each of two haptics.

27. An accommodating intraocular lens according to Claim 26 wherein protuberances extend outwardly from at least one side of said fingers.

28. An accommodating intraocular lens according to Claim 19 wherein said structural means on the distal end of at least one of two plate haptics comprises at least one prong protuberance extending laterally outwardly from the distal portion of the haptic.

29. An accommodating intraocular lens according to Claim 28 wherein prong protuberances extend outwardly from each side of the distal portion of the at least one haptic.

30. An accommodating intraocular lens according to Claim 29 wherein prong protuberances extend outwardly from each side of the distal end portions of each of the two haptics.

31. An accommodating intraocular lens according to Claim 19 wherein said structural means on said distal end of at least one of two haptics comprises wide distal end portions on two haptics extending oppositely from the optic.

32. An accommodating intraocular lens according to Claim 31 wherein said structural means on said distal end of at least one of two haptics comprise wide distal end portions on two haptics extending oppositely from the optic.

33. An intraocular lens according to Claim 19, wherein:

said structural means on at least one plate haptic distal portion comprises a notch defined in at least one edge portion of the plate haptic distal portion to substantially prevent entry of the notch edge into said fibrosis pocket defined by fibrosis about said proximally adjacent haptics portion to retain the haptic against movement in the proximal direction.

34. An intraocular lens according to Claim 33, wherein:

said structural means on at least one plate

haptic distal portion comprises a notch defined in each of the side edge portions of the plate haptic distal portions.

35. An intraocular lens according to Claim 33, wherein:

said structural means comprises a notch defined in at least one edge portion of the distal portions of at least two haptics extending at different angles from the optic.

36. An intraocular lens according to Claim 33, wherein:

said structural means comprises a notch defined in each edge portion of the distal portions of at least two haptics extending at different angles from the optic.

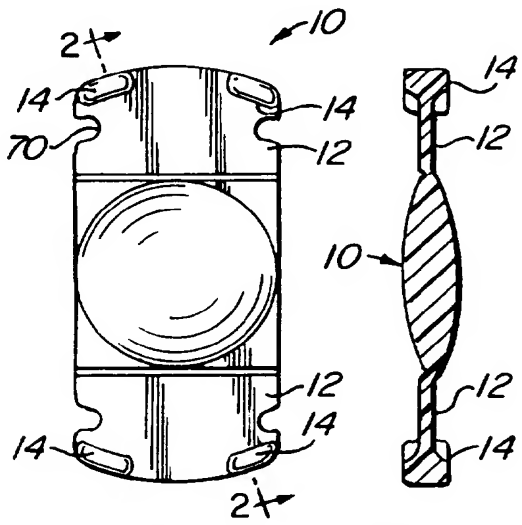

FIG-1

FIG-2

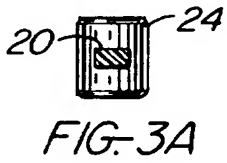

FIG-3A

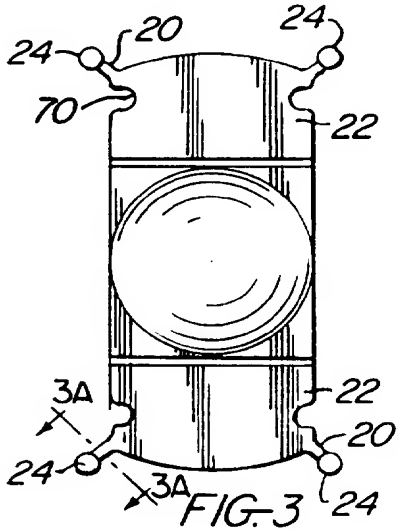

FIG-3

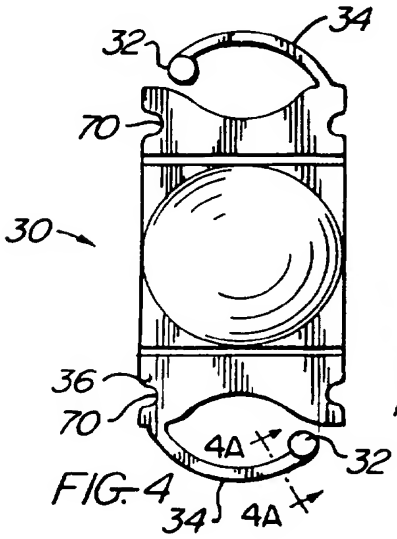

FIG-4

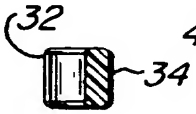

FIG-4A

FIG-5A

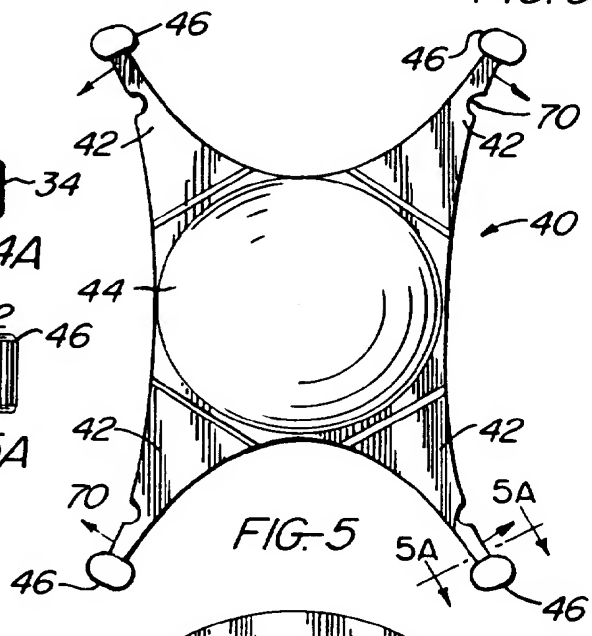

FIG-5

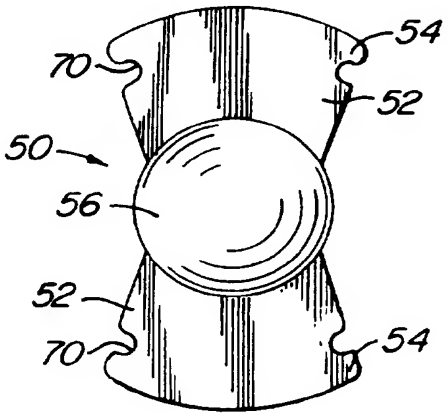

FIG-6

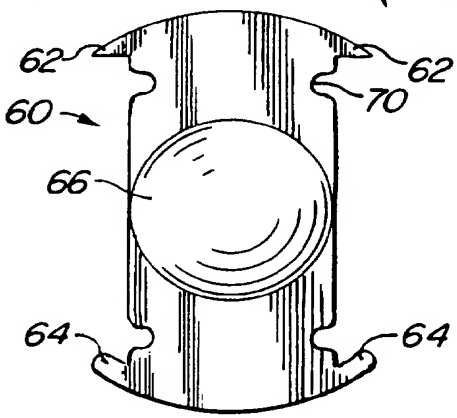

FIG-7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US96/15830

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :A61F 2/16
US CL :623/6

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 623/6

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 4,244,060 A (HOFFER) 13 January 1981, entire document.	1-3, 7-14 --- 4-6, 15-36
Y	US 5,047,051 A (CUMMING) 10 September 1991, entire document.	1-36
Y,P	US 5,522,891 A (KLAAS) 04 June 1996, Figs. 14, and 15.	19-27
Y	US 4,605,411 A (FEDOROV et al) 12 August 1986, Fig. 1.	15-18, 33-36

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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